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ADVANCEMENT OF MECHANICAL ASSETS OF BANANA FIBER REINFORCED EPOXY COMPOSITES LOADED UP WITH GROUNDNUT SHELL CINDER

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ABSTRACT

In the quick creating world, the fear for the natural contamination and the aversion of non-inexhaustible and for non-biodegradable assets has pulled in specialists looking to breed new eco-accommodating materials and items dependent on maintainability of values. The filaments from the regular foundations give unquestionable focal points over engineered fortification materials, that is, ease, minimizing thickness, non-poisonous quality, similar quality, and least squander transfer problems. In the present work, the banana fiber strengthened epoxy composites loaded up with groundnut shell fiery remains was readied and the mechanical properties of these composites are assessed. The composite examples with various groundnut shell fiery remains and epoxy weight divisions were set up by operating the hand lay-up procedure and by applying weight at room temperature. Afterward, the instances were tried for the assessment of mechanical properties, for example, rigidity, hardness, compressive quality and effect quality.

KEYWORDS: Natural Fibres & Fibre Composites

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Original Article

1. INTRODUCTION

1.1 Study on Accepted Fiber Based Polymer Material Composites

In the topical years, there is a colossal development in characteristic fiber built polymer composites of its different striking highlights like bio-degradability, adaptability, no abrasiveness, accessibility, minimal effort, light weight and so forth. Various scientists have performed incalculable investigations in upgrading mechanical properties of regular fiber-based polymer composites. Biswas et al. [1-4] considered the effect of length on mechanical lead of coir fiber fortified epoxy composites and saw that the hardness is reducing with the extension in fiber length up to 20 mm. An assessment on crush fiber invigorated thermoplastic material of composite shows that while the immovability is extended by a factor of 5.2, the advantage of the composite is seen as expanded by a factor of incredible than 2 with respect to the polymer [5]. Gowda et al. [6] analyzed the mechanical direct of jute surface fortified polyester composites and found that jute fiber based composites shows favored characteristics over those of wood-based composites. The mechanical properties of coir fiber/polyester composites were evaluated and the effect of trim load on the flexural nature of the composites is analyzed [7]. Luo and Netravali considered the moldable and flexural properties [8] of polymer material composites with different pineapple fiber content and differentiate them and the virgin. Amash and Zugenmaier [9] revealed the viability of cellulose fiber in improving the firmness and decreasing the damping in polypropylene cellulose composites. Dynamic mechanical physical methodology of regular strands like pineapple leaf fiber, sisal, oil palm void organic product fiber and so forth in

different mediums has been deliberated by Joseph et al. [10] and George et al. [11]. An absurd work has been done on various highlights of polymer material composites having braced with banana strands [12-15]. Chawla and Bastos inquired about the final product of fiber size [16] part on Energetic's modulus, versatility and impact métier of harsh jute strands in unsaturated polyester materials of pitch. Schneider and Karmaker considered the mechanical direct [17] of jute and similarly as kenaf fiber based polypropylene composites and pronounced that jute fiber gives perfect mechanical properties over kenaf fiber. A gainful report on the properties of henequen fiber and brought up that these strands have mechanical properties reasonable for assistance in thermoplastic gums by Cazaurang et al. [18]. Shinichi et al. [19] have thought about the effects of volume part and length on flexural properties of kenaf and bagasse fibers based composites. The mechanical direct of unidirectional hemp fiber strengthened epoxy composites is considered by Hepworth et al. [20]. Sapuan and Leenie [21] inspected the malleable and flexural lead of Musaceae/epoxy composites. Pavithran et al. [22] read the split energies for sisal, pineapple, banana and coconut fiber continued polyester composites and quick and dirty that, next to the coconut fiber, developing fiber quality was joined by broadening break significance of the composites. Harriette et al. [23], where it was examined the mechanical properties of flax as well as the polypropylene material of composites. Tobias [24] isolated the impact of fiber length and fiber content in banana fiber supported epoxy composites and revealed that the effect quality reached out with higher fiber substance and lower fiber length. Santulli [25] reviewed the post impact direct of plain-woven jute/polyester composites exhibited to low speed impact and proclaimed that the effect execution of these composites is poor.

1.2 Study on Artificial Fibre based Polymermaterial Composites

A ton of work has been done by various authorities on produced fiber based polymer material of composites. Huang et al. [26] considered the effect of water ingestion on the machine-driven properties of gem/polyester material composites. It was surmised that the breaking worth and malleable worry of the blends lessened bit by bit with extended water dousing time in light of the way that the enervating of croft among fiber and web of network. Ota et al. [27] pondered on the joined effect of imbuement temperature and fiber delighted on the properties of polypropylene precious stone fiber composites saw that the condensing stream document of the composites depend on fiber content, fiber length scatterings. The unbending nature and adaptable modulus was extended with growing in fiber substance. Jansons et al. [28] thought about on the effect of water ingestion, raised temperatures and weariness on the mechanical properties of carbon-fiber-braced epoxy composites. Kutty and Nando [29] considered the effect of taking care of parameters on the mechanical properties of short Kevlar aramid fiber-thermoplastic polyurethane composite and saw that getting ready parameters like nip opening, grinding extent and plant move temperature have over the top impact on the fiber course and thus on the mechanical properties of short Kevlar aramid fiber-thermoplastic polyurethane composite. Yuan et al. [30] thought about reinforcing effects of changed Kevlar fiber on the mechanical properties of wood-flour/polypropylene composites and saw that the development of kelvar Fiber improved the mechanical properties of wood-flour/polypropylene composites. Wang et al. [31] analyzed the mechanical properties of fiber glass and Kevlar woven surface reinforced composites and saw that mechanical direct depends insistently upon the fiber types. Cho et al. [32] pondered the mechanical direct of carbon fiber as well as epoxy material composites and found that the composites strengthened with nano particles improved mechanical properties, for instance, redesigned compressive quality and in plane shear properties. Chauhan et al. [33] considered on the effect of fiber stacking on mechanical properties, contact and wear lead of vinyl ester composites under evaporate and water lubed conditions and declared that the thickness of composite models is impacted scarcely by growing the fiber content.

1.3 Study on Hybrid Developed Fibre based Polymer Material Composites

The composites gotten by the circuit of any event two strands inside a lone grid are called as mutt or cross breed composites. Creamer fiber composites may be the mix of any rate two unmistakable trademark fibers or it may be the blend of typical or produced strands. The standard material, for instance, glass, carbon and boron fibers are expensive and the use of fiber like carbon or boron is protected remarkably in-flight application [34]. In this manner, it is imperative to examine the likelihood of using more affordable materials, for instance, ordinary fiber as help. Various pieces of crossbreed fiber-based polymer composites have inspected by various experts [34-54]. Jawaidet al. [35] inspected the mechanical deportment of cross type of the composites reliant on jute and just as oil palm fiber. It has been found that the use of creamer structure was fruitful in growing the resigned and dynamic machine-driven properties of the oil palm with epoxy composite by virtue of improved fiber/cross section line croft. Verma et al. [36] reviewed the mechanical properties of glass/jute creamer composites. Ashmed et al. [37] investigated the versatile properties and cut affectability of immaculate woven jute fiber and jute-glass surface invigorated material of polyester having crossbreed composites, coherently and probably. Dixit et al. [38] itemized an extraordinary development in the tractable and flexural properties of blend composites analogized with the un-half/half composite material. It was found that the breed composite showed better water ingestion deterrent. Ahmed et al. [39] likely investigated the effect of stacking keep running on mechanical resources of intertwined fiber of jute and just as glass surface strengthened polyester of cusp composites. Thew and Liao [40] instructed that mechanical properties of seeing bamboo just as the glass fiber reinforced cross type of composites rely upon fiber length, fiber weight extent and hold characteristics between the grid and the fiber. Exploratory assessment did by Mishra et al. [41] portrayed that the development of restricted amount of glass fiber to the pineapple leaf fiber and sisal fiber-braced polyester cross section improved the mechanical properties of the ensuing composites. The assessment also definite that the water digestion penchant of composites lessened in light of hybridization and treatment of biofibres. Pandya et al. [42] found that on setting glass surface layers in the outside and carbon surface layers in within the creamer composites fortifies higher pliable and outrageous tractable strain than cross breed composites with carbon surface layers in the outside and glass surface layers in within. Sreekala et al. [43] deduced that solidification of little volume division of glass fiber in composites realizes improved malleable and flexural properties. Velmurugan et al. [44] considered the pliable, shear, influence and flexural properties of the palmyra/glass fiber cream composites. The properties of the crossbreed were seen to increase always with the development of glass fiber. Goud and Rao [45] found a broad addition in the malleable, flexural, impact and hardness properties of Roystonearegia/glass fiber creamer composites with the extension in glass fiber stacking. Pothan et al. [46] considered on the banana-glass cream composites and found layering plan or the geometry of the composites significantly influences the dynamic lead of the composites. Examination of result shows that SLS treated half breed composites display preferable properties over antacid treated ones [47]. Zhong et al. [48] educated that the surface microfibrillation regarding sisal fiber improves the pressure quality, dependability, rigidity, inward holding quality and wear obstruction of the sisal material of fiber cross breed composite materials. Sanjeevamurthy and Srinivas [49] considered the impact of dampness ingestion on the mechanical possessions of the coconut output material of coir and sisal fiber half breed composites and contrasted it and the composites with dry strands. Venkateshwaran et al. [50] announced, in a consolidation of sisal fiber in banana and epoxy based composites up to half by mass brings about upgraded mechanical possessions and diminished dampness ingestion property. Girisha et al. [51] found that the hybridized composite shows more bulging give analogized with the composites having individual kind of characteristic.

2. EXPERIMENTAL PROCEDURE

2.1 Materials

In the breed of composite materials, defined as constituent which is unswerving and extant in more prominent amount is called network. The fundamental elements of the grid are to clasp or tie the fiber materials together, convey the heap equally amongst the filaments and shield the fiber from the mechanical and ecological harm. Epoxy pitches are interesting among all the thermoset tars because of a few elements. The unmistakable properties of epoxy, for example, high erosion and synthetic opposition, extraordinary bond to different substrate, great warm and mechanical assets, boundless result in electrical protecting properties, and the capacity to prepare under an assortment of circumstances make it reasonable network material for the fiber fortified composite materials. Epoxy gum has been utilized for the manufacture of polymer composites by a few creators. Because of the previously mentioned favorable circumstances, epoxy (LY 556) material having belonged to epoxide family is used as an instant material for this project. The epoxy resin used having density 1.15 g/cc and the consistent hardener is HY-951.

2.2 Fibre Material

In this material of compositions, the broken stage is normally firmer and more grounded than the persistent stage and is known as the support. In this polymer material of composites, the fortifying stage can either be stringy or particulates in eco nature. In Fiber Reinforced Polymer material of composites, fiber becomes a fortifying operator. Strands are the heap conveying individuals which give quality, firmness, warm solidness and other basic properties in FRP. On the off chance, the filaments are gotten from the regular assets like plants and other living species called as normal strands. Normal strands as fortification in composite materials have as of late pulled in the consideration of scientists due to their few focal points. The upsides of normal strands over manufactured filaments are minimal effort, low thickness, practically identical explicit properties, biodegradability, inexhaustibility, recyclability and less wellbeing hazard. More work done on diverse sorts of normal filaments for polymer composites. Among different regular filaments, banana is all the more plentifully accessible and modest. Banana strands were purchased from Sri Lakshmi gathering of businesses, Guntur.

Figure 2.1: Raw Banana Fibre.

2.3 Groundnut Shell Ash

Groundnut shells were kept in Electrical heater at 1400°C temperature for 30 minutes to consume totally. After this, consumed groundnut shells are pounded into fiery remains. At that point, the filler was dried in a broiler at a temperature of 250 °C for 3 hrs as shown in figures 3.2 and 3.3.

Figure 2.2: Ground Nutshell Ash.

Figure 2.3: Electrical Furnace.

3. PREPARATION OF MATERIALS

3.1 Chemical Treatment of Banana Fibres

The most significant factor to acquire a decent fiber strengthened composite is the grip between the framework and the fiber. Because of the nearness of a hydroxyl bunch in regular filaments, the partiality to dampness ingestion is high which prompts poor wet tability and feeble interfacial holding between the strands and the lattices, Along these lines, so as to create composites with better mechanical properties, it is important to bestow the hydrophobicity to the strands by appropriate compound medications. The impact of soluble base on the cellulose fiber is a swelling response, during which the common crystalline structure of the cellulose unwinds and subsequently, there is a grid change. Sodium hydroxide can cause a total cross section change, as opposed to different antacids (KOH and LiOH) that produce just halfway grid changes. The filaments were submerged in the 1% NAOH answer for 30 min and afterward washed with faucet water. The washed filaments are cleaned with material and after that set in stove at 50°C for 45 min for complete evacuation of dampness (figure 3.1).

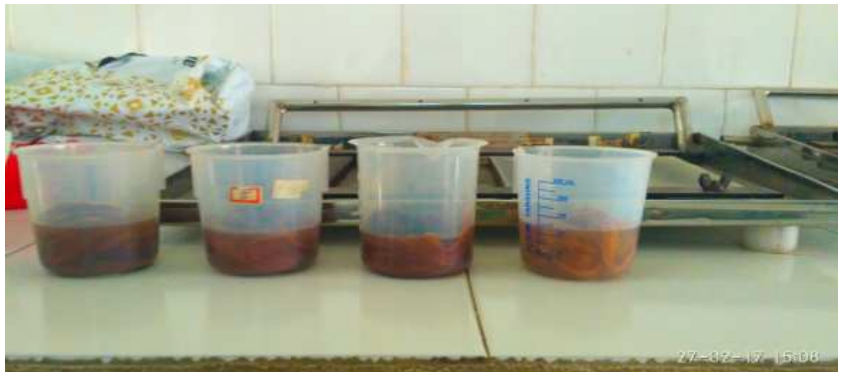


Figure 3.1: Banana Fibres Dipped in 1% NAOH Solution.

3.2 Preparation of Banana Mat

After chemical treatment, the individual banana fibres are taken and twisted to form uniform threads. Likewise, we have to prepare several threads. These threads were taken and arranged parallel to each other to get the required dimensions. After that we have to stretch the Banana fibres arranged perpendicular to its length. Like that we have to prepare eight Banana mats of dimensions of 250×250×1.5 mm^3 as shown in the figure 3.2.

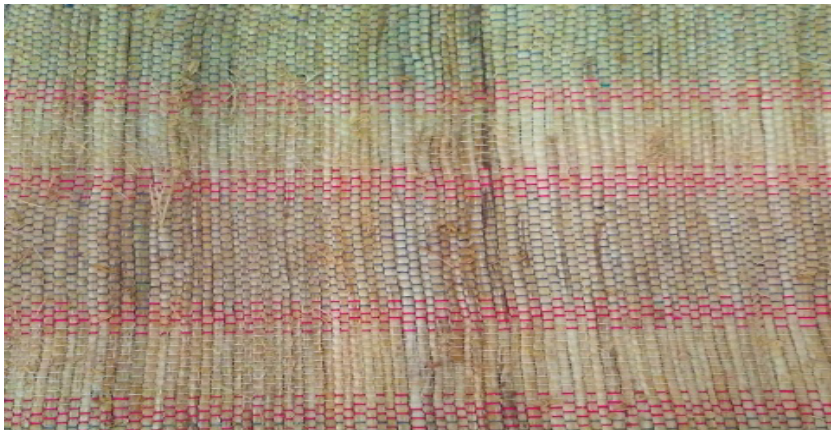


Figure 3.2: Banana Mat.

3.3 Preparation of Materials

In order to prepare the required specimen, it is essential to consider the following requirements of mould preparation using hand layup technique.

3.3.1 Mould preparation

A galvanised steel plate of dimensions 350×350×5 mm^3 is taken and made it into a box without lid using mallet and sheet metal cutter. The dimensions of rectangular steel box are of order 250×250×50 mm^3 is prepared which is used for the preparation of banana fibre reinforced epoxy composites filled with different weights of groundnut shell.

Figure 3.3: Rectangular Mould.

3.3.2 Hand Layup Process

In the mould we prepared, we have applied a thick layer of resin (10:1), after that we have placed banana mat with 0° angle. We applied another thick layer of resin and spread it uniformly over the mat. After that we have to place another banana mat with 90° angle. After that we have applied another thick layer of resin uniformly over the mat. After that we have to leave it for curing for 24hr at room temperature.

Like that we have to prepare four types of specimens.

- 250 g of (epoxy +hardener) + 45 g of banana mats
- 240 g of (epoxy +hardener) + 45 g of banana mats + 10g of groundnut shell ash
- 235 g of (epoxy +hardener) + 45 g of banana mats + 15g of groundnut shell ash
- 230 g of (epoxy +hardener) + 45 g of banana mats + 20 g of groundnut shell ash

Figure 3.4: Ground Nutshell Ash with Epoxy.

Figure 3.5: Silicon Spray.

From the figure 3.4 it is shown that the mixture of groundnut shell and epoxy which is later set to the formation of mats layer by layer using handlayup process. Banana mat is set for material preparation of layerd stacks. Banana mat of single layer is placed at the bottom and an epoxy mixed with groundnut shell is coated on to the layer which is applied thoughly. The layer filled with prepared epoxy is said to be sprayed with silicon (figure 3.5) so as to have a fine coating onto the epoxy coated mat. The process of applied coating of epoxy onto the banana mat and silicon is sprayed so as to provide coating of the layer. The process is repeated continuously until the required thickness of the specimen is prepared as shown in figure 3.6.

Figure 3.6: Hand Layup Process.

Figure 3.7: Composite.

The prepared material using layered technique is said to be cooled at room temperature for nearly 17 hours to get a fine settled material as shown in figure 3.7

4. RESULTS AND DISCUSSIONS

4.1 Mechanical Tests

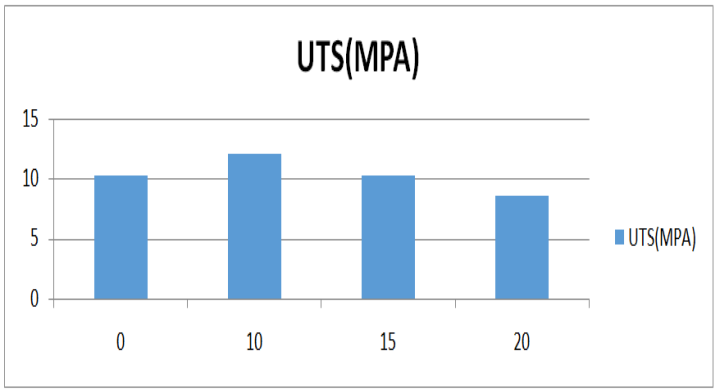
4.1.1 Tensile Test

The all-inclusive testing machine is utilized to decide the mechanical properties like: quality and the pressure, strain prolongation of the surrendered standard example made of the various blends. A widespread testing machine is utilized to test the pliable pressure and compressive quality of materials. It is named sometime later that it can perform numerous standard malleable and pressure tests on materials, parts, and structures. Here we have to check the strength of the composite which is in the standard cuboid in shape for measuring the tensile strength.

Table 4.1: Ultimate Tensile Strength Readings

S. No	Weight of Groundnut Shell Ash (grams)	Maximum Load (kN)	Load at Break (kN)	UTS (MPa)
1	0	2.72315	2.72	10.21
2	10	3.23015	3.23	12.02
3	15	2.79324	2.79	10.30
4	20	2.33734	2.33	8.61

From the results obtained from table 5.1, it is observed that the tensile strength of the material having 10 g of groundnut shell has more strength. The graph 5.1 plotted showing the high tensile strength in 10 g addition of groundnut shell.



Graph 4.1: Weight of Groundnut Shell ash vs Ultimate Tensile Strength

The graphical plots of groundnut shells having 0, 10, 15, 20 g addition to the materials prepared as shown from the figures.

Tensile Stress vs Strain Diagram

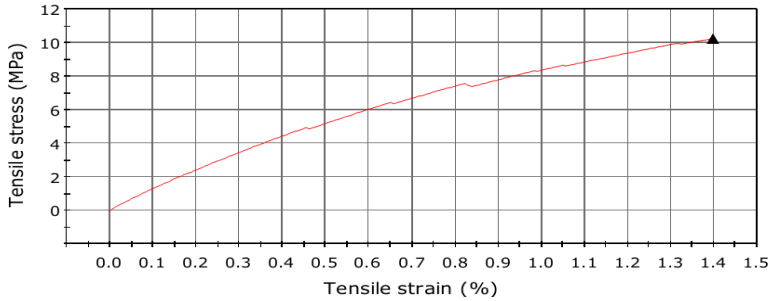


Figure 4.3: Zero gram of Groundnut Shell Ash Tensile Stress–Strain Graph.

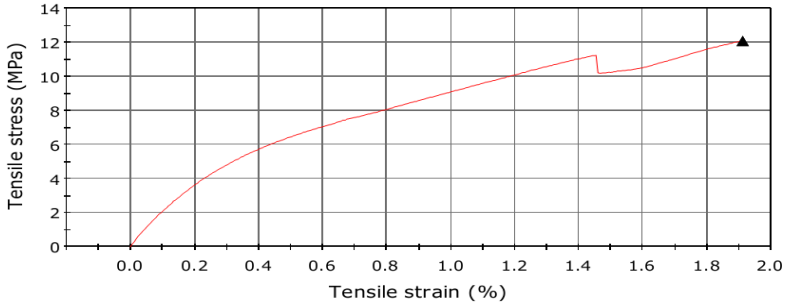


Figure 4.4: Ten grams of Groundnut Shell Ash Tensile Stress–Strain Graph.

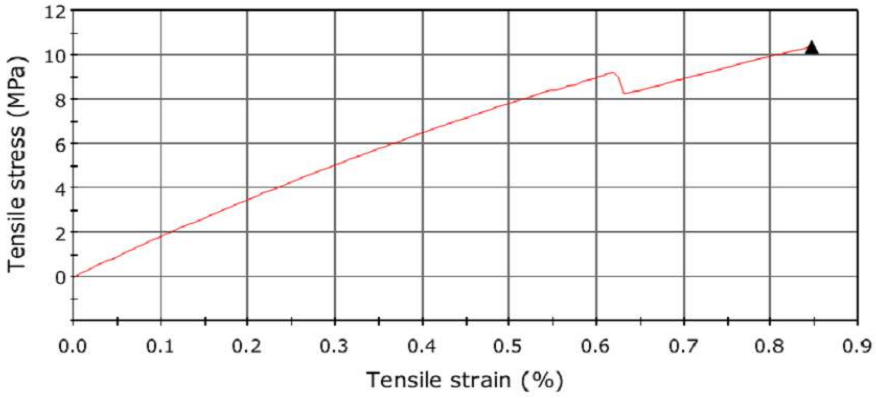


Figure 4.5: Fifteen grams of Groundnut Shell ash Tensile Stress–Strain Graph.

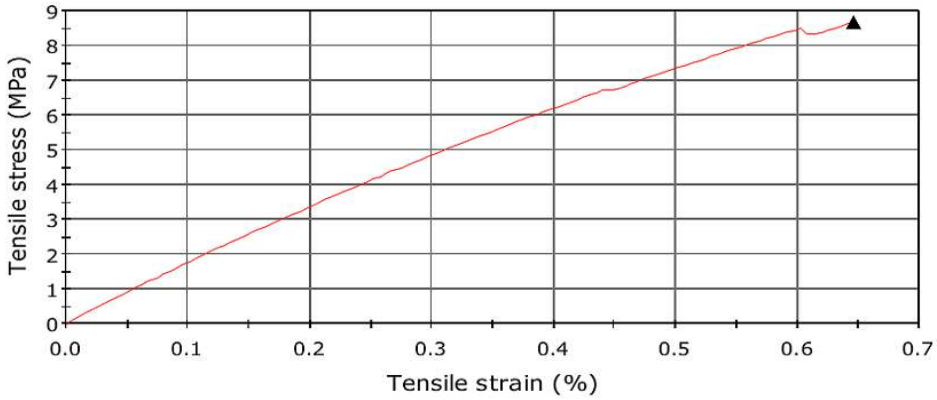


Figure 4.6: Twenty grams of Groundnut Shell Ash Tensile Stress-Strain Graph.

The plots having tensile stress and strain in addition to the groundnut shell is observed that the material having 10 g shows high stress to strain when compared to the compositions of 0,15 and 20 g.

4.2 HARDNESS TEST

It is a proportion of how safe strong issue is of different sorts of lasting change when a compressive burden is applied. Hardness is reliant on flexibility, versatile, solidness, pliancy, strain, and so forth.

Rockwell Hardness Test

The Rockwell Hardness Test technique comprises of indenting the test material with a jewel cone or solidified steel ball indenter. In our experimentation, The Rockwell Hardness Analyzer was utilized for investigation of hardness test with L-scale in Rockwell Hardness Testing having ¼ inch ball indenter. The indenter is constrained into the test material under a fundamental minor burden. Higher the hardness number lowers the temperature to quench it. The Rockwell Hardness test is carried out for different samples and values are tabulated.

Rockwell Hardness Number (RHN) =E-e

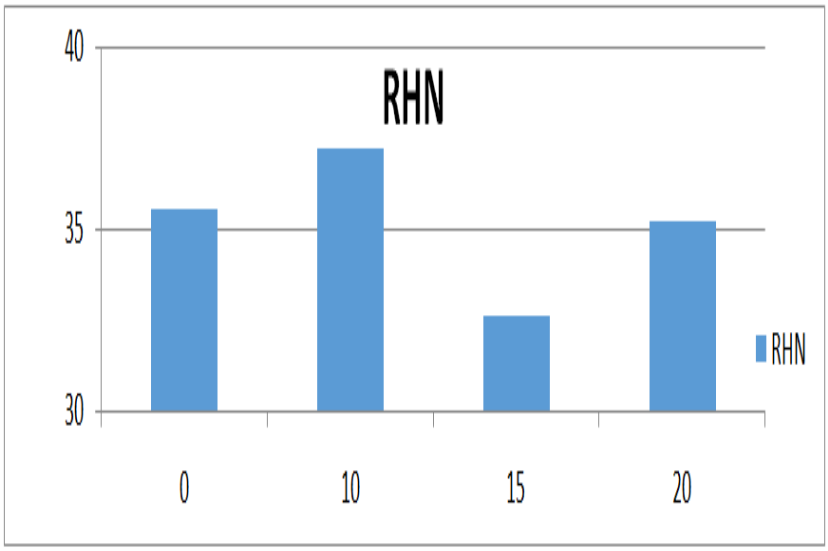
Where E = Constant of 100 for (diamond) or 130 units for (steel ball) indenter.

e = penetration depth in units of 0.002mm

Table 4.2: Hardness Test Results

S. No	Weight of Groundnut Shell ASH(gms)	Indentor Used	Load (kgf)	RHN	Average
1.	0	Diamond	60	38 33 36	35.6
2.	10	Diamond	60	35 38 39	37.3
3.	15	Diamond	60	31 34 33	32.6
4.	20	Diamond	60	33 37 36	35.3

From the results obtained from the table 4.2, it is observed that the hardness of the material having 10 g of groundnut shell has more strength. The graph 4.2 is plotted showing that high strength in 10 g addition of groundnut shell.



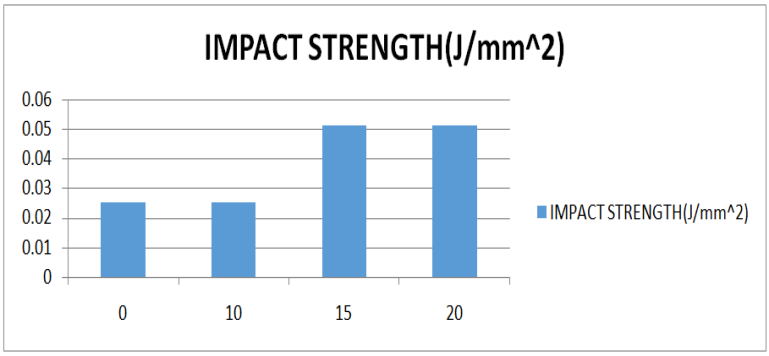
Graph 4.2: Weight of Groundnut Shell Ash vs Rockwell Hardness Number.

4.3 Impact Test

TABLE 4.3 Impact test results

S. No	Weight of Groundnut Shell Ash (grams)	Impact Strength on Izod(J/MM^2)
1	0	0.0252
2	10	0.0252
3	15	0.0512
4	20	0.0512

From the results obtained from the table 4.3, it is observed that the impact strength of the material having 20 g of groundnut shell has more strength. The graph 4.3 is plotted showing that high strength in 20 g addition of groundnut shell.



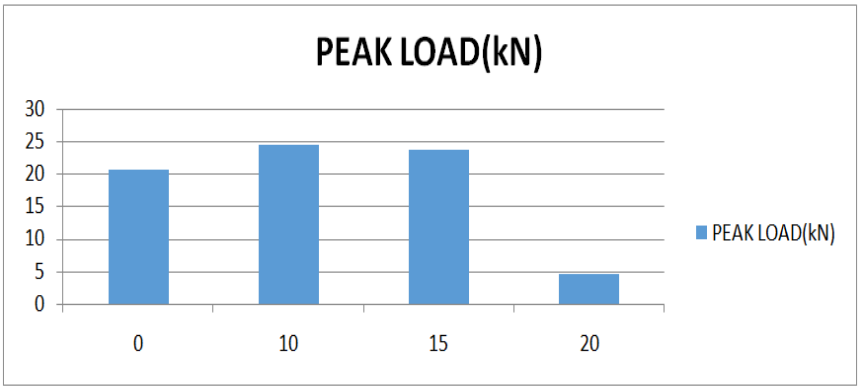
Graph 4.3: Weight of Groundnut Shell Ash vs Impact strength

4.4 Compression Test

Table 4.4: Compression Test Results

Weight of Groundnut Shell Ash (gms)	Peak Load(kN)
0	20.7
10	24.4
15	23.6
20	22.9

From the results obtained from the table 4.4, it is observed that the compression strength of the material having 10 g of groundnut shell has more load bearing capacity. Graph 4.4 is plotted showing that high strength in 10 g addition of groundnut shell.



Graph 4.4: Weight of Groundnut Shell Ash Vs Peak Load

5. CONCLUSIONS

The mechanical tests of all the four specimens were evaluated. The experimental investigation on the composites with different weight ratios have been carried out. The improvements in the material observed at the conclusions drawn from the present work are:

- 240 g of epoxy + 45 g of banana mats+ 10 g of groundnut shell shows high tensile strength of 12.02 MPA among other proportions.
- 240 g of epoxy + 45 g of banana mats + 10 g of groundnut shell shows high hardness number of 37.3.
- 240 g of epoxy + 45 gm of banana mats + 10 g of groundnut shell shows high peak load of 24.4kN.

- 235 g of epoxy + 45 g of banana mat and 15 g of groundnut shell and 20 g of Groundnut shell shows best impact strength of 0.0512 j/mm^2 among other proportions. The observations are useful for predicting the enduring behaviour of composites.

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